

## PATENT SPECIFICATION

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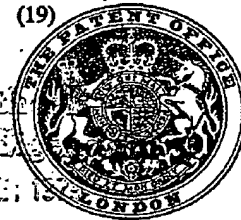
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## (54) ENTERTAINMENT MACHINES

(71) We, BARCREST LIMITED, a British Company of Richmond Street, Ashton-under-Lyne, Lancashire OL7 0AL, do hereby declare the invention, for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to entertainment machines, including both gaming machines and non-gaming amusement machines, of the kind (hereinafter referred to as the kind defined) which is operable by a player so as to perform a number of operations (particularly although not necessarily on a random basis) as initiated by the player, and to perform further operations determined by the first said operations (involving, for example, the actuation of a device which gives a win indication in the event that a predetermined arrangement, such as a predetermined combination or sequence, of the first said operations, is achieved).

The invention is particularly, although not exclusively, concerned with a machine of this kind which is of the fruit machine type, that is, a machine having a number of rotatable members such as drums or discs carrying symbols or indicia, which members are, in play, set in rotation and subsequently come to rest with a combination of said indicia displayed to the player, the duration of rotation of each member, and hence the displayed combination of indicia, being determined wholly or largely on a random basis and a reward mechanism being actuated in the event that said displayed combination is of a predetermined nature.

With a fruit machine of the kind described in the preceding paragraph, hereinafter referred to as a fruit machine of the kind described, it is necessary to identify and evaluate the position of the rotatable members when they come to rest in order that the reward mechanism can be appropriately

actuated or not as the case may be. One way of effecting such identification and evaluation involves providing different arrangements of holes in each member corresponding to different possible stopping positions thereof and illuminating an array of light sensitive devices through such holes so that different electrical outputs are obtained from the array for different stopping positions, the electrical output of the or each such array being fed to an appropriate electronic evaluation circuit. One arrangement of this kind is described in our prior Patent No. 1,368,622.

With this known kind of arrangement, problems arise having regard to the fact that there is a requirement for fruit machines to be manufactured, and for existing fruit machines to be modified from time to time, so as to make available machines which differ in relation to the identity of the symbols or indicia and/or evaluation of obtained combinations thereof so as to provide variety in the playing of games with such machines. Problems arise due to the fact that in order to accommodate such differences it may be necessary to modify the identification and/or evaluation circuitry or to vary the arrangements of holes in the members, which in each case adds greatly to the complexity and expense of manufacture.

Also, with said known fruit machine, in addition to the identification and evaluation of the positions of the rotatable members, it is necessary for other machine operations, for example, the operation of control buttons by the player, the operation of the coin mechanism as coins or tokens are inserted therein, to be identified and evaluated, and further, it is necessary for yet other machine operations, such as actuation of drive mechanisms for the drums or discs, actuation of pay-out mechanisms and the like, to be controlled.

Accordingly, much electrical and electronic circuitry is involved whereby manufacture and also repair and maintenance work are rendered complicated and expensive.

An object of the present invention is to provide an entertainment machine of the kind described which is simple and inexpensive to manufacture, maintain and repair and which can be readily adapted as and when required to accommodate different modes of play.

According to the present invention therefore there is provided an entertainment machine of the kind which is operable by a player, after actuation of the machine by insertion of one or more coins or tokens into a coin mechanism of the machine, so as to perform a number of operations as initiated by the player, and to perform further operations determined by the first said operations, which machine incorporates a control system arranged to respond to and effect control of machine operations, wherein said control system incorporates a processing device, and a plurality of interchangeable programme devices are provided for individual detachable incorporation in the control system for feeding different respective programme information to the processing device corresponding respectively to adaptation of the machine for the playing of different games therewith, whereby the machine can be adapted for playing a selected such game by selection of the pertaining said programme device for said incorporation in the control system.

With this arrangement it will be appreciated that the use of a control system incorporating a processing device and interchangeable, detachable programme devices can greatly simplify manufacture in so far as it is possible to manufacture a plurality of machines with identical standardised control system except for the programme devices, said programme devices being the same or different for the different machines in accordance with the desired similarity or difference in the modes of play or other features of the machines.

Thus, on the one hand, it is not necessary to design and construct a separate control system for each machine, standardised control systems can be used even in the case where machines are being manufactured which have different constructional features (such as different operational mechanisms), differences in said features being accommodated by differences in the detachable programme devices; and, on the other hand, in the case where it is desired to introduce differences between machines, it need not be necessary to introduce differences in constructional features or to introduce specially designed different control systems, such differences

can instead be introduced simply by introduction of different programme devices.

As an example, with a fruit machine of the kind hereinbefore described using drums or discs with holes therein, in order to change the mode of play or the like, this can be done in the case where such machine incorporates the features of the present invention by using a different programme device thereby obviating the need to replace the drums or discs with other drums or discs having different arrangements of holes. Similarly, changes in pay-outs, values of coins or tokens to be used with the machine, control operations available to the player and the like, can also be readily accommodated.

Further, it will be appreciated that maintenance and repair work can be much facilitated. Thus, insofar as a standardised control system can be used, it can be convenient to keep a stock of replacement control systems whereby in the event that a fault is detected in an installed control system such control system can be conveniently replaced even on site.

The provision of a detachable programme device facilitates testing insofar as the existing programme device can be removed and readily replaced with a further like device or with a special programmed testing device to aid fault tracing. Indeed, having regard to the possibility of standardisation of control system and the possibility of using programmed testing device it will be appreciated that fault tracing and repair work can be particularly facilitated for on-site repair personnel.

Most preferably, in order to facilitate manufacture, maintenance and repair each programme device for a machine is in the form of a plug-in module. Preferably also, the control system as a whole is formed as a detachable part of the machine and thus said control system may comprise a modular unit incorporating said processing device, said unit being arranged for detachable connection with electrical circuitry of the machine and being arranged to receive each said programme device in detachable connection therewith.

With regard to the processing device this is most preferably a sequential processing device particularly a microprocessor.

With the machine of the invention, said control system may be connected to a sensing arrangement for detecting the position of movable members of the machine. Thus, the machine of the invention may be a fruit machine of the kind described, the said sensing arrangement being operable to sense positioning of rotatable drums or discs of the machine. In this case, the sensing arrangement may comprise an arrangement of light sensitive devices which in use are illuminated

through holes in the drums or discs, for example, such as is described in our aforementioned prior Patent.

The invention is not however intended to be restricted to fruit machines and may find application in the context of other gaming machines or non-gaming amusement machines which operate on the basis of chance and/or skill.

The invention will now be described further by way of example only and with reference to the accompanying drawing which is a circuit diagram showing the control system of one form of an entertainment machine according to the present invention.

The entertainment machine is a fruit machine having four drums with symbols, such as fruit, marked around the periphery of same and which are rotatably mounted within a box-shaped floor standing housing having a window at the front thereof. During play, the drums are set in rotation for different random periods of time by pressing a button or the like after the machine has been actuated by insertion of one or more coins or tokens through a slot in the housing into a coin mechanism of the machine. Rotation of the drums may be effected by application of impulses thereto from solenoid operated mechanism, and stopping of the drums may be effected by engagement of latches of further solenoid operated mechanisms with toothed peripheries of the drums, whereby each drum can only stop in one of a plurality (say 20) of predetermined positions. In each said position, a respective symbol of each drum is displayed through the said window.

When the drums come to rest, arrays of photosensitive devices 1 are illuminated through holes in the drums, there being a different arrangement of holes for each said position of each drum, whereby the electrical outputs of the arrays 1 are representative of the positions at which the drums come to rest. The electrical outputs are evaluated and a reward mechanism is actuated if the combination of stopping positions of the drums corresponds to a predetermined winning combination of displayed symbols. The reward mechanism may involve paying out coins or tokens and/or awarding free games or other action.

In accordance with conventional practice the machine may have a "hold" facility whereby one or more drums can be held against rotation at the option of the player by pressing an appropriate button. Such hold facility may be made available to the player on an occasional basis which may be determined in a random or predetermined manner. The machine may also have other facilities.

The arrangement so far described is similar to that disclosed in British Patent

No. 1,368,622 and reference is made to the specification of such Patent for a more detailed description of such arrangement.

Unlike the aforesaid known arrangement, however, the present entertainment machine has a control system, as shown in the accompanying drawing, which incorporates a MPU (microprocessor) which is connected via control, address and data buses to a RAM (Random Access Memory), a ROM (Read Only Memory) and/or PROM (Programmable Read Only Memory), a clock device 7, a power supply 8, a pulse generator 9, and a PIA (Peripheral Interface Adaptor). The PIA acts to convert simultaneous combinations of signals to sequential digital signals and vice versa and has data input terminals connected to the aforesaid arrays of photosensitive devices 1 and to switches 2 associated with the coin mechanism and other operating switches 2 of the machine, and data output terminals connected to switching transistors 3 connected to lamps 4 and to triacs 5 connected to solenoids 6.

In use, input signals are fed to the PIA in response to action taken by the player, from the switches 2 associated with the coin mechanism, and from operating switches 2 operated manually by the player such as the main control button, 'hold' buttons, and the like. These input signals are converted to sequential digital signals which are passed to the MPU. The information conveyed by the signals is processed in conjunction with information stored in the RAM and ROM/PROM and sequential signals are then fed to the PIA to cause signals to be applied to selected triacs 5 and to selected transistors 3 so as to trigger same. The actuated triacs 5 are connected to appropriate solenoids 6 which act to perform functions such as setting the drums in rotation, stopping the drums, recording coins inserted, and so on. The transistors 3 actuate appropriate lamps 4 to give a visual indication of the operative state of the machine.

When the drums come to rest, a signal is applied by the PIA to appropriate transistors 3 to cause lamps 4 to be actuated for illumination of the aforesaid photosensitive devices 1 through the holes in the drums. Combinations of signals from the photosensitive devices 1 are then applied to the PIA and are processed by the MPU in conjunction with the RAM and ROM/PROM. In the event that a winning combination is identified a signal is applied to appropriate ones of the triacs 5 and to appropriate transistors 3 to cause the reward mechanism to be actuated to pay out coins or tokens and to actuated lamps 4 to indicate that a win has been achieved. Alternatively, or additionally, after processing of information from the photosensitive devices 1, a 'hold' 130

facility may be actuated together with actuation of an appropriate indicator lamp 4, or other action may be taken.

In more detail, the operation of the control system is as follows:—

The MPU is powered by the power supply 8 and performs successive processing operations as successive impulses are fed thereto from the clock device 7. The RAM is used to store information produced during processing, such information relating for example, to the timing of the rotation of the drums, to the amount of money or tokens and number of games credited to the player, and the like. The PROM/ROM provides a permanent store of information relating to the interpretation of data fed to and produced by the MPU, for example, information relating to interpretation of data from the photosensitive devices 1 in terms of the symbols on the drums displayed to the player, information relating to the interpretation of data from the machine operating switches 2 in terms of the machine functions corresponding to such switches, information relating to the interpretation of MPU outputs in terms of individual triacs 5 and transistors 3 to be actuated, information relating to the amount of data fed to the MPU in terms of winning and losing situations, and the like.

In order to minimise duplication of circuitry, multiplexing techniques may be used. Thus, for example, the arrays of photosensitive devices 1 associated with the drums may be connected to the PIA via a common set of leads 10 and a respective single additional lead 11 may be provided between each array 1 and the PIA. Output signals from the photosensitive devices of each array 1 are only fed along the leads 10 to the PIA when an enabling signal is transmitted along the respective additional lead 11. Such enabling signals are applied to the additional leads 11 in sequence so that the output signals from the arrays 1 are applied sequentially to the PIA.

Similarly, there may be two banks of said triacs 5, each comprising say seven triacs, connected via a common set of seven leads 12 to the PIA device, and a further lead 13 may be provided for selecting the bank of triacs desired to be placed in operative connection with the PIA via the set of leads 12. When a 0 signal is applied to the lead 13 one bank of triacs is placed in such operative connection and when a 1 signal is applied to the lead 13 the other bank is placed in such operative connection. If desired a similar arrangement may be used with the switch transistors 3.

Further, in the case where a digital display device (not shown) comprising a plurality of 7-segment LED (light emitting diode) digital display units is used, for example,

for digitally displaying credited number of games or coins or tokens, or the like, such display device may be connected via a set of seven leads common to all display units, and a respective additional lead for each unit, to the PIA via said switch transistors 3 or other devices. In this case, each unit can only be actuated in the case where an enabling signal is present on the respective additional lead. In order to give a continuous display the units are repeatedly actuated sequentially under the control of rapid sequential control impulses which may be generated in a manner described herein-after.

Still further, with a view to minimising duplication, the PROM/ROM may incorporate provision for masking interpretation of triacs and/or switch transistors 3 whereby, by incorporating in a processing procedure a step whereby such masking is effected, it is possible to use the triacs 5 and/or switch transistors 3 for performing alternative functions as and when desired without disrupting the interpretation recorded in the PROM/ROM.

With a view to minimising problems arising due to a control system defect, provision is made for the operation of control system to be checked at regular intervals. This is effected under the control of the pulse generator 9 connected via the control bus to the usual non-maskable input of the MPU. The pulse generator is powered from a.c. mains and includes a full wave non-smoothed rectification circuit connected to a Schmidt trigger circuit which gives a sharp impulse in response to each 'ripple' of the output of the rectification circuit, such impulses being at 10 millisecond intervals. As each such impulse is applied to the non-maskable input of the MPU, normal processing operations are temporarily arrested and the MPU then performs a short checking routine, involving for example examination of data in selected positions of the RAM device. Such checking therefore takes place every 10 milliseconds. If no defect is found, the MPU continues with its arrested main processing routine. If a defect is found appropriate action is taken for example the MPU may reset by jumping to the commencement of its main processing routine via a jump routine of the ROM/PROM.

The MPU may also be caused to reset if tampering with the machine is detected, for example, if an aerial within the machine detects disruptive signals from a nearby signal transmitter. The MPU may also be arranged to hold at reset for, say two seconds after switching on of the machine, to allow for a 'warm up' time.

The 10 millisecond impulses from the generator 9 may also be used as control impulses

in the case where a multiplexed digital display device is used as hereinbefore described.

Further, such impulses may be used to  
5 introduce the random variation in the stopping time for the drums. Thus, each drum may be arranged to stop after a period of time equal to the sum of a respective predetermined time interval plus an additional  
10 small time interval. The additional small time interval is obtained from a timing function of the RAM. That is, the RAM is incremented repeatedly through a timing cycle by the impulses from the generator 9 and  
15 said small time interval is equal to the time elapse from the start of such timing cycle at the instant when the player presses the main control button of the machine to set the drums in rotation.

20 The usual interrupt request input of the MPU is controlled by switches of the coin mechanism whereby on insertion of a coin or token, the main processing routine can be interrupted to allow crediting of coins or  
25 tokens inserted into the machine even in the case where play is in progress. Usual lock-out mechanisms to prevent insertion of coins or token during play can therefore be omitted.

30 As can be seen from the drawing the MPU, and associated components including the RAM, the PIA and components 3, 5, 7, 8, 9 may be in the form of a standardised modular unit housed in a metal box structure detachably secured in position in the  
35 machine and having electrical connectors for detachable connection of the circuitry of the unit to circuitry and electrical components (such as components 2, 4, 6) of the  
40 machine; and the ROM/PROM may be in the form of a printed circuit board module enclosed in a plastics housing and having a multi-terminal plug connector which can be plugged in to an appropriate socket in said  
45 modular unit, the ROM/PROM module being arranged to be held in position detachably by such plug-in connection alone or in conjunction with an appropriate additional releasable retention clip or the like.

50 In this way, any number of machines can be provided with drums with the same arrangement of holes therein, and with the same standardised module. Thus differences in play between different machines can be  
55 achieved at the time of manufacture and also subsequently to manufacture even on site, by inserting differently programmed ROM/PROMS or by substituting or modifying existing such ROM/PROMS as the case  
60 may be, whilst at the same time if desired changing the symbols on the drums for example by use of strips carrying the symbols which can be applied around the drums, whereby initial manufacture and subsequent  
65 modification can be much simplified. For

example, a standardised moulded plastics drum with holes moulded therein can be used. Further, with the use of standardised components, repair and maintenance work can be much simplified particularly having  
70 regard to the convenience with which replacement components can be stocked. Still further, due to the use of a detachable PROM/ROM in conjunction with a standardised module, testing of the control system can be effected in a simple manner by  
75 insertion of an appropriate test device into the control system in place of the PROM/ROM.

Said test device may be an appropriate  
80 programmed PROM/ROM or other memory device which operates in the following manner:

Firstly the test device instructs the MPU to perform a particular processing operation.  
85 If the result of this agrees with a predetermined result recorded in the test device, the test device proceeds automatically to the next test routine.

If there is a fault in the MPU or associated components, the test device will not proceed to the next test routine. In said  
90 next test routine, the test device actuates transistor switches 3 in sequence so that the associated lamps are illuminated. The  
95 sequence is repeated until the test device is advanced to its next test routine which is effected by pressing the main control switch of the machine. In the next test routine the triacs are repeatedly actuated in  
100 sequence causing the associated solenoids to be operated, until the main control switch is again pressed. In a final test routine the drums in turn are each indexed around the  
105 twenty positions thereof and at each position the outputs of the devices 1 are checked against information in the test device. Indexing is effected by feed of timed impulses to drive solenoids for the drums and timing of the pulses can conveniently be derived  
110 from the output of the pulse generator 9.

With this test sequence it will be appreciated that the person performing the test does not need to possess detailed knowledge of the mode of operation of the machine.  
115 Instead, such person can test the machine in the following simplified manner: If the test device does not advance to the test routine which actuates the transistor switches 3, the associated lamps 4 will not  
120 be illuminated and it is likely that a component of the control system is faulty and the modular unit of the control system can be removed and replaced with a new modular unit which can conveniently be  
125 effected on site.

If the test device does advance to the test routine which actuates the switches 3, all lamps 4 will be illuminated in sequence unless a lamp or the associated circuitry is  
130

faulty. A visual indication of a fault condition is given. Similarly, when the triacs 5 are actuated in sequence, a solenoid 6 will fail to operate in the case where such solenoid or associated circuitry is faulty.

With the test routine in which the drums are indexed, in the case where the output of the devices 1 fails to check with the information in the test device, indexing will be arrested at the particular position at which the discrepancy has occurred.

It is also possible to test the modular unit of the control system when not installed in the machine, for example, as a check subsequent to manufacture of the modular unit, in a manner similar to the above described test sequence, by connecting said test device or a similar test device to the modular unit and connecting the modular unit to a machine-simulation device which has: switching stages connected to indicator lamps simulating the switches 3 and triacs 5 of the machine, four banks of switches corresponding to the sensing devices 1 of the machine drums, and switches corresponding to machine switches. With this arrangement the indicator lamps are sequentially operated in predetermined manner if no fault condition exists, the banks of switches corresponding to the sensing devices are being manually operated in place of the drum indexing procedure of the aforementioned testing sequence.

It is of course to be understood that the invention is not intended to be restricted to the details of the above embodiment, which are described by way of example only.

Thus, for example, the invention is not restricted in application to fruit machines having drums but may also be fruit machines of the scanning lamp type as well as entertainment machines of any other suitable kind.

#### WHAT WE CLAIM IS:—

1. An entertainment machine of the kind which is operable by a player, after actuation of the machine by insertion of one or more coins or tokens into a coin mechanism of the machine, so as to perform a number of operations as initiated by the player, and to perform further operations determined by the first said operation, which machine incorporates a control system arranged to respond to and effect control of machine operations, wherein said control system incorporates a processing device, and a plurality of interchangeable programme devices are provided for individual detachable incorporation in the control system for feeding different respective programme information to the processing device corresponding respectively to adaptation of the machine for the playing of different games therewith, whereby the machine can be adapted for playing a selected such game by selection of

the pertaining said programme device for said incorporation in the control system.

2. A machine according to claim 1, characterised in that each said programme device is in the form of a plug-in module.

3. A machine according to claim 1 or 2, characterised in that said control system is formed as a detachable part of said machine.

4. A machine according to claim 3, characterised in that said control system comprises a modular unit incorporating said processing device, said unit being arranged for detachable connection with electrical circuitry of the machine and being arranged to receive each said programme device in detachable connection therewith.

5. A machine according to any one of claims 1 to 4, characterised in that said processing device comprises a sequential processing device particularly a microprocessor.

6. A machine according to any one of claims 1 to 5, characterised in that said control system is connected to a sensing arrangement for detecting the position of movable members of the machine.

7. A machine according to claim 6, which is a fruit machine of the kind described, characterised in that said movable members are rotatable drums or discs of the fruit machine.

8. A machine according to claim 7, characterised in that said sensing arrangement comprises an arrangement of light sensitive devices which are arranged to be illuminated through holes in the drums or discs.

9. A machine according to any one of claims 1 to 8, characterised in that said control system is connected to switches which are actuated on operation of the machine.

10. A machine according to claim 9, characterised in that said switches include switches of said coin mechanism which are actuated on insertion of coins or tokens into the mechanism.

11. A machine according to claim 9 or 10, characterised in that said switches include manual switches which can be operated by a player.

12. A machine according to any one of claims 1 to 11, characterised in that said processing device is arranged to operate electronic switching devices via the intermediary of an interface unit.

13. A machine according to claim 12, characterised in that said switching devices comprise triacs arranged to control operation of solenoids.

14. A machine according to claim 12 or 13, characterised in that said switching devices comprise transistors arranged to control operation of lamps.

15. A machine according to any one of claims 1 to 14, characterised in that multiplexing techniques are used for feeding in-

formation to and/or from the processing device.

16. A machine according to any one of claims 1 to 15, characterised in that a pulse generator is connected to an interrupt input of the processing device whereby operation of the processing device is arranged to be interrupted and a checking procedure put into operation as each pulse is fed to said input.

17. A machine according to claim 16, characterised in that said pulse generator is arranged to produce an impulse for each half cycle of a.c. mains supply.

18. A machine according to claim 16 or 17, characterised in that the processing device is arranged to jump to the start of a processing routine if said checking procedure detects a fault condition.

19. A machine according to any one of claims 16 to 18, characterised in that said pulse generator is used to determine a random time period for controlling a machine operation on a random basis.

20. A machine according to any one of claims 1 to 19, incorporating a coin mechanism characterised in that said mechanism is arranged to control an interrupt input of the processing device whereby coins or tokens inserted into said mechanism can be credited even when the processing device is performing a processing operation.

21. A machine according to any one of claims 1 to 20, characterised in that there is provided a programmed test device connectable to the control system in place of said programme device for testing operation thereof.

22. A machine substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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## COMPLETE SPECIFICATION

**1 SHEET**

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